vicariance has occurred conforms with the hypothesis, but the stygofauna in these aquifers does represent substantial biodiversity. In addition, it has extended the salinity range of stygal habitat in continental groundwaters from oligohaline-limnic (< 5 g L^{-1}) to polyhaline (18–30 g L^{-1}), possibly for the first time globally.

In the Australian arid zone, groundwater calcretes form within these palaeodrainage channels as a result of carbonate deposition due to evaporation from near surface groundwaters. They form in a particular part of a hydrogeological cycle that repeats itself along the length of the palaeodrainage lines, especially on the Western Shield. As a result, discrete calcrete bodies have formed along the length of the palaeodrainage channels, and some contain aquifers variously of fresh to hypersaline water. In places, karst processes within these calcretes have formed open conduit systems, thus providing habitat most suitable for subterranean fauna, both terrestrial and aquatic, while at the same time having properties ideal for water abstraction for human use, both attributes being sparse in the arid zone.

The calcrete aquifers contain subterranean aquatic faunas (stygofauna) that are both very diverse and often of a relictual nature. They include higher taxa new to Australia, amongst them Spelaeogriphacea, a Pangaean lineage now restricted to the hypogean zone of Gondwanan fragments and an order new to Australia, the genus *Tiramideopsis* (Acarina: Hydracarina) previously known from India, and Phreodrilidae (Oligochaeta). In addition, numerous species, largely in new genera, occur in the Bathynellidae (Syncarida), Copepoda (Cyclopoidea, Harpacticoidea, Calanoidea), Ostracoda (Candoninae), Amphipoda (Melitidae, Ceinidae, crangonyctoid), Isopoda (Phreatoicidea, Flabellifera and Oniscoidea) and Dytiscidae (Coleoptera).

Westralian Superbasin: is the tethyan connection supported by the extant anchialine community?

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Anchialine systems are near coastal groundwaters that are affected by marine tides but having no surface connection to the sea. They have limited or no surface exposure, salinity stratified waters and typically are described from limestone or basalt caves. Anchialine systems typically contain phyletic and geographical relictual taxa and in recent years at least ten new families and even a new class (the Remipedia) of crustaceans have been described from anchialine caves, particularly on islands. The Cape Range region, northwestern Australia, has the only continental anchialine ecosystem known in the southern hemisphere.

A rich obligate subterranean aquatic fauna (stygofauna), principally Crustacea, occurs in the anchialine system of the Cape Range peninsula and Barrow Island , including the only southern hemisphere representatives of several higher level taxa. At least six lineages of Crustacea (*Lasionectes*, Remipedia; *Halosbaena*, Thermosbaenacea; *Haptolana*, Isopoda, Cirolanidae; *Danielopolina*, Ostracoda, Thaumatocyprididae; speleophriid and misophrioid copepods; pseudocyclopiid calanoid copepods; epacteriscid calanoid copepod; and possibly Hadziidae, Amphipoda) belong to genera or higher taxa whose general distribution pattern is coincident with the “Tethyan” track. Typically the global distributions of the genera (or higher taxon) is Cape Range, Lanzarote in the Canaries and the northern greater Caribbean region with some taxa in the Galapagos and Somalia.

This tethyan distribution pattern is generally considered to have formed in the epicontinental seas of the late Mesozoic, but this is long after the opening of the Atlantic. However, fossil evidence indicates that one lineage was already stygal in the Jurassic (leading to *Danielopolina*, Thaumatocyprididae), while in the extant species of *Danielopolina* and *Halosbaena* the Australian species is the sister group of those on either side of the Atlantic. Both sets of evidence are consistent with a Jurassic relictualisation of the Australian taxa and hence that the fauna characteristic of these anchialine systems spread westwards in the epicontinental seas formed by the development of Tethys into areas now the Mediterranean and Atlantic.

The persistence of anchialine ecosystems may occur because they are protected from surface vicissitudes both by being subterranean and by the possession of a stable ecotone associated with stratification of the water column. The anchialine systems are complex with strong physico-chemical stratification associated with thermohaloclines and involving multiple layers of hydrogen sulphide, anoxia and chemoautotrophic energy production probably associated with both nitrogen and sulphur bacteria. The typical 'tethyan' fauna largely occurs below the thermohalocline.

The geological context of the region is relevant. The Westralian Superbasin (Permian -Cretaceous) which straddled Australia and the formerly adjacent parts of Gondwana was epicontinental until late Mesozoic times. Fossil evidence suggests it was intermittently connected with Tethys. The only part of the superbasin remaining in the tropical Australian landmass is in the vicinity of the Cape Range peninsula, northwestern Australia, which has continuously been a shallow water marine environment since the Early Jurassic and which, since the Cretaceous, has been juxtaposed to the edge of the continental shelf in a marine carbonate depositional environment.

Evolutionary origins of cave cockroaches in the genus *Paratemnopteryx* Saussure (Blattodea: Blattellidae)

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For over 150 years scientists have debated the origins of cave dwelling organisms. To investigate the origin of cavernicolous fauna in North Queensland, I selected the cockroach genus *Paratemnopteryx* Saussure (Blattaria, Blattellidae) to test alternative hypotheses for the evolution of cave dwelling species within the genus. The genus contains 13 described species, 11 of which are endemic to Australia, and five of which are cave dwelling (Roth, 1990; Slaney in press). Of the 13 described species three were recently collected and described, one surface dwelling species, *P. rosensis*, from southeast Queensland, and two cavernicolous species, *P. kookabinnensis* and *P. weinsteini*, from central Western Australia and northeast Queensland respectively (Slaney, in press). My initial hypothesis was that some surface dwelling species within this genus gave rise to cavernicolous species as a result of increasing aridity in Australia during the late Cenozoic. To test this, I used a combined morphological and molecular approach.

One hundred and sixty four *Paratemnopteryx stonei* and *P. weinsteini* adults were collected from seven caves in tropical North Queensland to investigate the degree of morphological modification, which may reflect various stages of adaptation to cave life. Morphometric studies, using canonical discriminant and cluster analyses, indicated morphological discontinuity between cave populations from the different geographic regions (Slaney and Weinstein, 1997). The body dimensions particularly important in discriminating among cave populations were tegmen length (both sexes), and secondly, tegmen width for males and tarsus length for females.

To reconstruct the phylogeny of the genus *Paratemnopteryx* using a traditional morphological approach, 30 morphological characters were chosen, 11 binary and 19 multistate. The most informative sources of taxonomic characters were the male tergal glands, and the genitalia and associated structures for both sexes (Slaney, 1999). The resulting most parsimonious trees were consistent with previously proposed relationships within the genus.

In using a molecular approach to investigate relationships within the genus